West coast of Newfoundland capelin (*Mallotus villosus* M.) and Atlantic herring (*Clupea harengus harengus* L.) larval survey, part 9: Description of the data collected in partnership with the industry (Barry Group) in July 2009

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2012

WEST COAST OF NEWFOUNDLAND CAPELIN (*Mallotus villosus* M.) AND ATLANTIC HERRING (*Clupea harengus harengus* L.) LARVAL SURVEY, PART 9: DESCRIPTION OF THE DATA COLLECTED IN PARTNERSHIP WITH THE INDUSTRY (BARRY GROUP) IN JULY 2009

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ABSTRACT

Grégoire, F., W. Barry, J.-J. Barry, J. Barry, J.-L. Beaulieu, and M.-H. Gendron. 2012. West coast of Newfoundland capelin (*Mallotus villosus* M.) and Atlantic herring (*Clupea harengus harengus* L.) larval survey, part 9: Description of the data collected in partnership with the industry (Barry Group) in July 2009. Can. Data Rep. Fish. Aquat. Sci. 1242: vi + 25 pp.

In partnership with the Barry Group, a larval survey was conducted on the west coast of Newfoundland from July 15 to 18, 2009. The survey's objective was to measure the abundance of sampled eggs and larvae and to describe their spatial distribution. Eggs were most abundant in the CYT group (cunner [*Tautogolabrus adspersus*] and yellowtail flounder [*Limanda ferruginea*]) and the CHW group (cod [*Gadus morhua*], haddock [*Melanogrammus aeglefinus*], and witch flounder [*Glyptocephalus cynoglossus*]). These were followed by the H4B group, which includes hake (*Urophycis* spp.), fourbeard rockling (*Enchelyopus cimbrius*), and butterfish (*Peprilus triacanthus*). In addition, Atlantic mackerel (*Scomber Scombrus*) eggs were collected at all stations. Of the 17 larva species identified, the most abundant were cunner and capelin (*Mallotus villosus*) followed by yellowtail flounder, witch flounder, Atlantic mackerel, and Atlantic herring (*Clupea harengus harengus*). Temperature and salinity profiles according to depth were made at each station. All biological and oceanographic data that were collected were compiled and are presented in the tables, figures, and appendices in this document. These data will be analyzed and published in a forthcoming report.

RÉSUMÉ

Grégoire, F., W. Barry, J.-J. Barry, J. Barry, J.-L. Beaulieu et M.-H. Gendron. 2012. West coast of Newfoundland capelin (*Mallotus villosus* M.) and Atlantic herring (*Clupea harengus harengus* L.) larval survey, part 9: Description of the data collected in partnership with the industry (Barry Group) in July 2009. Can. Data Rep. Fish. Aquat. Sci. 1242: vi + 25 pp.

En partenariat avec le Groupe Barry, un relevé larvaire a été réalisé sur la côte ouest de Terre-Neuve entre le 15 et le 18 juillet 2009. Ce relevé avait pour objectifs de mesurer l'abondance des œufs et des larves échantillonnés et de décrire leur distribution spatiale. Les plus abondants groupes d'œufs ont été CYT (tanche-tautogue [*Tautogolabrus adspersus*] et limande à queue jaune [*Limanda ferruginea*]) et CHW (morue [*Gadus morhua*], aiglefin [*Melanogrammus aeglefinus*] et plie grise [*Glyptocephalus cynoglossus*]). Ces derniers ont été suivis du groupe H4B qui comprend la merluche (*Urophycis* spp.), la motelle à quatre barbillons (*Enchelyopus cimbrius*) et la stromatée à fossette (*Peprilus triacanthus*). De plus, des œufs de maquereau bleu (*Scomber scombrus*) ont été récoltés à toutes les stations. Parmi les 17 espèces de larves identifiées, les plus abondantes ont été celles de la tanche-tautogue et du capelan (*Mallotus villosus*). Ces dernières ont été suivies de la limande à queue jaune, de la plie grise, du maquereau bleu et du hareng (*Clupea harengus harengus*). Des profils de la température et de la salinité de l'eau en fonction de la profondeur ont été réalisés à chaque station. Toutes les données biologiques et océanographiques recueillies ont été compilées et sont présentées dans les tableaux, figures et annexes du présent document. Ces données seront analysées et publiées dans un rapport à venir.

INTRODUCTION

In collaboration with the industry (Barry Group), four larval surveys were carried out on the west coast of Newfoundland in July 2004, 2005, 2007, and 2008. The main objective of these surveys was to sample and calculate the abundance of capelin (*Mallotus villosus*) and Atlantic herring (*Clupea harengus harengus*) larvae, two very important species for this region's economy. In 2004 and 2005, the survey sampling area was located from south of Bonne Bay to Port-au-Port Bay. In 2007 and 2008, the survey extended to St. George's Bay, which is one of the main fishing areas for pelagic fish on the west coast of Newfoundland (Figure 1). In addition to capelin and Atlantic herring, eggs and larvae from a very large number of species were sampled during these surveys (Grégoire et al. 2005, 2006, 2008, 2011).

A fifth and final larval survey was conducted in July 2009. The sampling plan was the same as for the 2007 and 2008 surveys. This report presents the physico-chemical data measured in 2009 as well as counts of fish eggs and larvae from samples.

MATERIALS AND METHODS

The 2009 larval survey was conducted aboard the *Ocean Leader*, a large seiner from the west coast of Newfoundland. Egg and larva samples were collected using two bongo nets (Posgay and Marak 1980) with 61 cm openings and mesh size of 333 microns. The minimum tow duration was set at 10 minutes. The tows followed a saw-tooth pattern (Hempel 1973) between the surface and a maximum depth of 50 m, or down to 5 m off-bottom for shallower stations. Two flowmeters were fixed near the opening of the nets to measure the volume of water filtered. Once on deck, the nets were rinsed with sea water. Samples from one of the nets were kept in a formaldehyde solution (4–5%) (Hunter 1985) and the others in an ethanol solution (95%). A CTD (Sea-Bird Electronics, Inc., model SBE-19) probe was placed on the frame holding the nets. After data validation, mean temperature and salinity were calculated for 2 m intervals between the surface and 20 m and at 5 m intervals for depths exceeding 20 m.

The plankton samples were analyzed in the Department of Fisheries and Oceans laboratory at Mont-Joli, Quebec, in the fall of 2009. To facilitate sorting, each sample was fractionated based on the Van Guelpen beaker technique (Van Guelpen et al. 1982). The egg and larva identification criteria were primarily from Fritzsche (1978), Elliott and Jimenez (1981), and Fahay (1983). Results from these analyses were recorded and validated.

RESULTS

Physical-chemical parameters

The survey was conducted from July 15 to 18, 2009. Despite poor weather conditions, 39 of the 46 stations initially selected were sampled (Figure 2). Nets were damaged at station 2, and technical problems with the CTD probe occurred at stations 9, 13 and 20. The position and depth of stations are presented in Table 1, along with the depth sampled, tow duration, and the volume of water filtered. Temperature profiles are presented in Appendix 1. Between 0 m and 12 m, the

warmest temperatures were measured in St. George's Bay and Port-au-Port Bay (Figure 3). Water cooled rapidly beyond 12 m, in particular on the west side of St. George's Bay and in the area between Bay of Islands and Bonne Bay. Temperatures below 10°C were measured at depths of about 25 m (Table 2). Salinities increased slightly between the surface and the bottom (Table 3). These increases were even more significant for the first stations samples in the Bay of Islands, where salinities were lower at the surface due to a higher freshwater input.

Egg and larva counts

Eggs were found at all stations sampled (Appendix 2). The most abundant were from the CYT and CHW groups. The CYT group is associated with cunner (*Tautogolabrus adspersus*) and yellowtail flounder (*Limanda ferruginea*) and the CHW group with cod (*Gadus morhua*), haddock (*Melanogrammus aeglefinus*), and witch flounder (*Glyptocephalus cynoglossus*). The third most abundant group was H4B, which includes hake (*Urophycis* spp.), fourbeard rockling (*Enchelyopus cimbrius*), and butterfish (*Peprilus triacanthus*). Atlantic mackerel (*Scomber scombrus* L.) eggs were found at all stations. Of these groups, development stages one and two (Girard 2000) were the most abundant. American plaice (*Hippoglossoides platessoides*) and windowpane flounder (*Scophthalmus aquosus*) eggs were also sampled during the survey.

Larvae from 17 fish species were collected. The most abundant were from cunner and capelin, followed by yellowtail flounder, witch flounder, Atlantic mackerel and Atlantic herring (Appendix 3). Broken and unidentifiable larvae were sampled on a few occasions. The egg and larva abundance data will be analyzed in detail in a forthcoming document.

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Table 1. Description of the stations and tows completed during the capelin and Atlantic herring larval survey of July 2009.

STATION NUMBER	DATE (yyyy/mm/dd)	TIME (hh:mm) (NDT)	LONGITUDE °W (degrees minutes)	LATITUDE °N (degrees minutes)	DEPTH Station bottom (m)	DEPTH Maximum sampled (m)	TOW DURATION (mm:ss)	VOLUME OF WATER FILTERED (m^3)
1	2009/07/15	11:35	58° 12'	49° 09'	180	50	12:08	264
2*	2009/07/15	12:22	58° 12'	49° 12'	183	65	11:35	---
3	2009/07/15	15:22	58° 12'	49° 27'	41	35	11:58	254
4	2009/07/15	16:32	58° 12'	49° 33'	63	50	18:46	286
5	2009/07/16	7:33	58° 18'	49° 06'	60	45	12:02	291
6**	---	---	58° 18'	49° 11'	---	---	---	---
7	2009/07/15	13:23	58° 18'	49° 15'	78	52	11:15	309
8	2009/07/15	14:13	58° 18'	49° 20'	40	35	11:43	297
9***	2009/07/15	17:53	58° 18'	49° 27'	60	50	11:53	305
10**	---	---	58° 24'	49° 11'	---	---	---	---
11	2009/07/15	20:20	58° 24'	49° 15'	39	34	13:07	352
12	2009/07/15	19:14	58° 24'	49° 20'	47	41	11:58	259
13***	2009/07/18	8:15	58° 30'	49° 03'	47	36	12:01	350
14	2009/07/18	9:49	58° 30'	49° 07'	88	55	9:49	266
15	2009/07/15	21:13	58° 30'	49° 12'	64	50	13:34	183
16	2009/07/16	10:58	58° 36'	48° 51'	44	40	10:39	281
17	2009/07/18	6.49	58° 36'	48° 57'	33	20	11:15	319
18	2009/07/18	7:38	58° 36'	49° 03'	47	33	9:45	266
19	2009/07/18	9:10	58° 36'	49° 07'	63	46	12:44	230
20***	2009/07/16	13:00	58° 42'	48° 39'	36	25	10:58	242
21	2009/07/16	12:09	58° 42'	48° 45'	26	22	10:02	287
22	2009/07/16	18.02	58° 42'	48° 51'	19	9	10:36	287
23**	---	---	58° 42'	48° 57'	---	---	---	---
24	2009/07/16	13:57	58° 48'	48° 36'	26	15	8:36	234
25	2009/07/16	14:56	58° 48'	48° 39'	26	15	8:18	219
26	2009/07/16	15:33	58° 48'	48° 42'	17	10	8:19	238
27	2009/07/16	20:22	58° 48'	48° 48'	26	15	9:54	306
28	2009/07/16	20:46	58° 48'	48° 51'	43	35	10:24	284
29	2009/07/16	16:23	58° 54'	48° 39'	14	9	8:47	255
30	2009/07/17	7:26	58° 54'	48° 45'	29	17	9:39	275
31	2009/07/17	8:45	59° 06'	48° 39'	43	35	11:56	313
32	2009/07/17	10:17	59° 18'	48° 30'	58	50	11:32	127
33	2009/07/17	19:46	59° 06'	48° 28'	67	49	13:58	288
34	2009/07/17	17:52	58° 54'	48° 28'	65	51	12:06	257
35**	---	---	58° 42'	48° 30'	---	---	---	---
36	2009/07/17	16:18	58° 36'	48° 30'	45	35	12:34	316
37	2009/07/17	15:44	58° 36'	48° 27'	89	52	11:54	257
38	2009/07/17	11:22	59° 12'	48° 24'	85	51	13:21	295
39	2009/07/17	18:55	59° 00'	48° 24'	91	56	12:02	182
40**	---	---	58° 48'	48° 24'	---	---	---	---
41	2009/07/17	14:58	58° 42'	48° 24'	45	35	13:14	384
42	2009/07/17	12:20	59° 06'	48° 18'	96	50	12:13	248
43	2009/07/17	13:23	58° 54'	48° 18'	105	50	11:59	236
44	2009/07/17	14:02	58° 48'	48° 18'	43	35	11:25	224
45**	---	---	59° 00'	48° 12'	---	---	---	---
46**	---	---	58° 54'	48° 13'	---	---	---	---

* Nets damaged

** Not sampled (bad weather)

*** Malfunction of the CTD probe

Table 2. Mean water temperature (°C) by depth interval (m) for the stations sampled during the capelin and Atlantic herring larval survey of July 2009.

DEPTH	STATION																					
(m)	1	2*	3	4	5	6**	7	8	9***	10**	11	12	13***	14	15	16	17	18	19	20***	21	22	23**
0-2	14.17	15.42	13.56	12.97	13.83		13.45	13.49			13.26	12.90		14.53	12.66	14.36	14.63	14.61	14.18		15.56	14.89	
2-4	14.08	14.01	13.40	12.94	13.83		13.38	13.41			13.11	12.95		14.51	12.65	14.36	14.63	14.58	14.16		15.55	14.81	
4-6	13.87	13.64	13.07		13.83		13.33	13.21			12.63	12.85		14.48	12.60	14.36	14.60	14.56	14 15		15.54	14.70	
6-8	13.83	13.51	12.74		13.84		13.29	12.92			12.35	12.55		14.44	12.45	14.32	14.59	14 53	14 14		15.48	13.97	
8-10	13.81	13.36	12.57		13.84		13.23	12.58			12.13	12.36		14.39	12.13	14.25	14.65	14.51	14.10		15.42	12.80	
10-12	13.79	13.20	12.48		13.84		13.20	12.46			12.01	12.21		14.36		14.19	14.69	14.49	13.99		15.38	12.26	
12-14	13.50	13.14	12.41		13.82		13.17	12.36			11.82	11.91		14.32		14.17	14.55	14.44	13.75		15.31	11.15	
14-16	13.51	12.87	12.34		13.62		13.17	12.20			11.57	10.52		13.97		14.14	14.45	13.73	13.50		15.16	10.50	
16-18	13.38	12.43	12.27		13.36		13.15	11.63			11.34	8.90		12.85		14.10	14.24	12.13	12.52		13.75		
18-20	12.90	12.08	12.19		13.18		13.14	10.39			10.46	7.12		11.72		14.07	14.13	11.75	11.31		12.90		
20-25	12.15	10.98	11.38		12.84		12.97	8.58			7.09	6.13		10.24		12.90	13.71	10.94	9.61		9.66		
25-30	9.47	9.18	8.70		12.29		10.78	7.66			4.59	5.00		6.16		7.98	10.45	7.49	4.15		6.40		
30-35	7.34	6.68	6.68		9.87		7.28	6.11			4.37	4.14		3.50		6.72		3.74	2.41				
35-40	4.91	5.23	4.99		5.57		5.30	4.37			4.08	3.22		2.20		5.13		2.78	1.80				
40-45	2.85	3.73	3.86		3.42		3.55	3.32			3.93	2.70		1.73		4 64		2.31	1.71				
45-50	1.85	2.17			2.07		2.58					2.33		0.98					1.51				
50-55	1.03	1.56			1.67		1.51							0 58					1.17				
55-60	0.58	1.22					1.14							0.51									
60-65	0.43	0.85																					
65-70		0.50																					
75-80		0.43																					

Table 2. (Continued).

DEPTH	STATION																						
(m)	24	25	26	27	28	29	30	31	32	33	34	35**	36	37	38	39	40**	41	42	43	44	45**	46**
0-2	15.99	14.85	15.66	14.96	14.95	14.89	14.79	14.79	14.24	15.22	15.23		15.86	15.53	14.70	14.95		15.64	14.44	14.44	15.61		
2-4	15.97	14.85	15.66	14.96	14.96	14.81	14.79	14.80	14.22	15.21	15.13		15.59	15.50	14.55	14.88		15.62	14.45	14.45	15.60		
4-6	15.95	14.82	15.64	14.96	14.96	14.70	14.79	14.79	14.22	15.09	15.06		15.31	15.41	14.45	14.81		15.61	14.45	14.45	15.50		
6-8	15.89	14.61	15.61	14.95	14.95	13.97	14.79	14.78	14.21	14.91	15 04		15.01	15.33	14.40	14.72		15.60	14.44	14.44	15.10		
8-10	14.94	14.03	15.46	14.94	14.94	12.80	14.79	14.79	14.13	14.67	15.00		14.85	15.21	14.14	14.20		15.60	14.42	14.42	14.83		
10-12	11.42	12.52	14.66	14.93	14.93	12.26	14.79	14.50	13.89	14.02	14.86		14.63	15.04	13.81	13.53		15.59	14.31	14.31	14.44		
12-14	9.42	11.05	13 17	14.92	14.92	11.15	14.78	13.85	13.54	13.67	14.10		14.39	14.92	13.09	13.19		15.58	14.20	14.20	14.12		
14-16	8.38	10.37	12.76	14.89	14.89	10.50	14.71	13.32	13.56	13.45	13.39		14.24	14.77	12.59	12.88		15.56	14.00	14.00	13.61		
16-18	7.91	9.63	12.64	14.84	14.84		14.49	12.84	13.38	13.01	12.35		14.09	14.34	12.34	12.41		15.45	13.75	13.75	12.43		
18-20	7.57	8.86		14.67	14.67		14.27	11.71	11.96	12.20	11.51		13.80	13.37	11.53	11.33		14.88	13.42	13.42	11.26		
20-25	7.28	8.13		14.41	14.41		13.97	10 27	10.31	10.96	10.00		12.25	11.81	9.59	9.51		10.99	12.36	12.36	9.76		
25-30								6.73	7.92	8.87	7.57		7.65	6.98	7.48	7.93		6.36	9.46	9.46	7.73		
30-35								5.28	5.43	7.40	5.31		2.90	3.30	5.44	6.10		4.51	6.26	6.26	5.52		
35-40								3.87	3.57	5.01	3.24		1.12	1.57	4.33	4.58		3.05	5.58	5.58	3.65		
40-45								2.30	2.82	3.05	2.07		0.72	0.70	3.55	3.70		1.31	4.45	4.45	3.03		
45-50									2.14	1.82	1.43			0.36	2.94	2.80			2.86	2.86			
50-55									1.67	1.20	0.98			0.25	2.49	2.10			1.91	1.91			
55-60									1.35		0.84			0.16	1.64	1.51			1.43	1.43			
60-65																1.70							
65-70																							
75-80																							

* Nets damaged

** Not sampled (bad weather)

*** Malfunction of the CTD probe

Table 3. Mean water salinity by depth interval (m) for the stations sampled during the capelin and Atlantic herring larval survey of July 2009.

DEPTH	STATION																					
(m)	1	2*	3	4	5	6**	7	8	9***	10**	11	12	13***	14	15	16	17	18	19	20***	21	22	23**
0-2	30.18	28.95	30.79	31.43	30.91		31.17	31.15			31.33	31.34		30.73	31.43	30.96	30.69	30.73	31.05		30.10	30.95	
2-4	30.18	30.36	30.95	31.30	30.93		31.12	31.15			31.36	31.36		30.75	31.43	30.97	30.70	30.73	31.05		30.92	30.96	
4-6	30.40	30.91	31.10		30.93		31.16	31.17			31.34	31.37		30 80	31.40	30.98	30.71	30.74	31.05		30.93	30.97	
6-8	30.54	31.02	31.25		30.94		31.13	31.14			31.37	31.37		30.85	31.35	31.01	30.74	30.74	31.05		30.95	30.98	
8-10	30.65	31.04	31.27		30.94		31.12	31.14			31.36	31.38		30.92	31.40	31.05	30.83	30.74	31.08		30.97	31.05	
10-12	30.81	31.04	31.26		30.95		31.12	31.15			31.37	31.38		30.95		31.06	30.92	30.76	31.09		30.97	31.06	
12-14	30.92	31.05	31.26		30.96		31.11	31.15			31.37	31.38		30.97		31.04	30.98	30.77	31.14		30.96	31 15	
14-16	31.04	31.08	31.25		30.97		31.11	31.14			31.37	31.34		30.99		31.04	30.98	30.88	31.23		31.00	31.18	
16-18	31.10	31.10	31.24		30.99		31.09	31.14			31.35	31.41		31.14		31.03	30.99	31.18	31.31		31.06		
18-20	31.08	31.13	31.23		31.08		31.09	31.24			31.38	31.58		31.24		31.02	31 05	31.21	31.37		31.21		
20-25	31.10	31.19	31.23		31.10		31.06	31.35			31.40	31.63		31.29		31.09	31 11	31.25	31.47		31.31		
25-30	31.28	31.34	31.34		31.13		31.16	31.43			31.62	31 68		31.59		31.34	31.33	31.48	31.75		31.69		
30-35	31.34	31.57	31.49		31.29		31.40	31.57			31.70	31.73		31.78		31.53		31.84	31.85				
35-40	31.38	31.80	31.63		31.60		31.56	31.85			31.76	31.82		31.88		31.74		31.96	31.90				
40-45	31.57	31.78	31.94		31.88		31.64	31.92			31.82	31.92		31.94		31.80		32.34	31.90				
45-50	31.76	31.98			32.12		31.73					32.07		32.01					31.94				
50-55	31.83	32.13			32.16		31.86							32.09					31.99				
55-60	31.91	32.10					31.96							32.14									
60-65	31.98	32.00																					
65-70		32.17																					
75-80		32.26																					

Table 3. (Continued).

DEPTH	STATION																						
(m)	24	25	26	27	28	29	30	31	32	33	34	35**	36	37	38	39	40**	41	42	43	44	45**	46**
0-2	30.88	30.93	30.91	30.75	30.75	30.95	30.90	30.77	30.71	30.86	30.79		30.25	30.68	30.97	30.90		30.75	31.00	31.00	30.72		
2-4	30.88	30.93	30.91	30.76	30.76	30.96	30.90	30.77	30.70	30.91	30.85		30.53	30.73	31.00	30.93		30.77	31.03	31.03	30.73		
4-6	30.87	30.93	30.91	30.76	30.76	30.97	30.90	30.77	30.70	30.95	30.89		30.76	30.84	31.02	30.95		30.78	31.03	31.03	30.77		
6-8	30.86	30.95	30.90	30.78	30.78	30.98	30.90	30.78	30.69	30.99	30.91		30.80	30.90	31.01	30.98		30.78	31.03	31.03	30.91		
8-10	30.88	30.95	30.91	30.84	30.84	31.05	30.90	30.80	30.69	30.99	30.92		30.88	30.92	31.07	31.05		30.78	31.04	31.04	30.98		
10-12	31.16	31.10	30.97	30.88	30.88	31.06	30.90	30.92	30.77	31.08	30.94		30.96	30.95	31.12	31.09		30.79	31.04	31.04	31.03		
12-14	31.29	31.23	31.09	30.89	30.89	31.15	30.91	31.05	30.95	31.09	31.00		31.00	30.94	31.18	31.09		30.79	31.04	31.04	31.06		
14-16	31.33	31.30	31.15	30.89	30.89	31.18	30.93	31.11	31.06	31.12	31.06		31.01	30.94	31.17	31.12		30.80	31.05	31.05	31.05		
16-18	31.38	31.37	31.17	30.90	30.90		31.01	31.17	30.94	31.12	31.03		31.01	30.92	31.18	31.15		30.80	31.07	31.07	31.10		
18-20	31.39	31.48		30.93	30.93		31.12	31.19	30.95	31.15	31.13		31.00	30.93	31.22	31.22		30.86	31.09	31.09	31.15		
20-25	31.40	31.33		31.00	31.00		31.16	31.28	31.02	31.21	31.22		31.00	31.08	31.32	31.30		31.16	31 13	31.13	31.28		
25-30								31.54	31.14	31.39	31.43		31.34	31.36	31.47	31.43		31.46	31.30	31.30	31.44		
30-35								31.67	31.43	31.48	31.64		31.70	31.58	31.61	31.55		31.54	31.56	31.56	31.65		
35-40								31.81	31.66	31 64	31.87		32.00	31.80	31.69	31.65		31.66	31.60	31.60	31.86		
40-45								32.13	31.88	31.84	32.00		32.29	31.95	31.80	31.72		32.02	31.70	31.70	32.35		
45-50									32 09	32.05	32.10			32.03	31.90	31.83			31.85	31.85			
50-55									32.35	32.17	32.18			32.06	31.99	31.95			32.03	32.03			
55-60									32.74		32.24			32.12	32.19	32.06			32.32	32.32			
60-65																31.73							
65-70																							
75-80																							

* Nets damaged

** Not sampled (bad weather)

*** Malfunction of the CTD probe

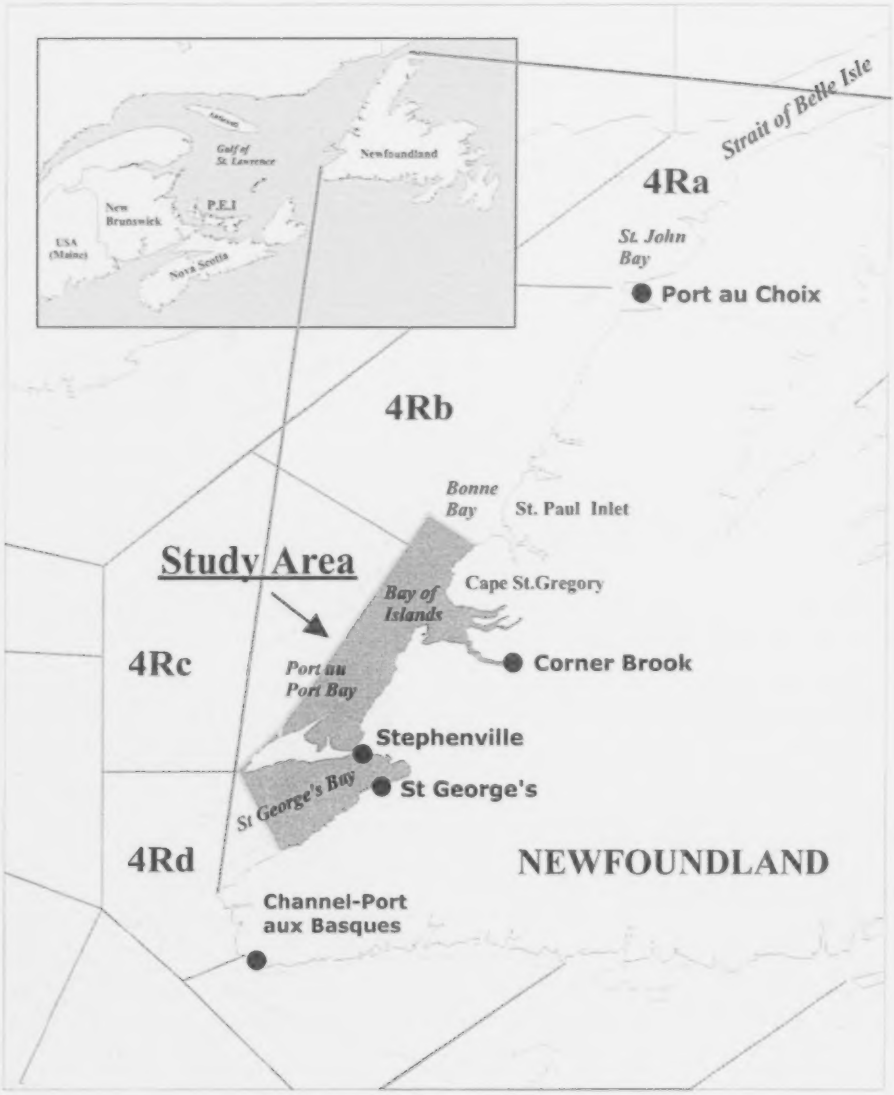


Figure 1. Map of the west coast of Newfoundland showing the study area and the other locations mentioned in the document.

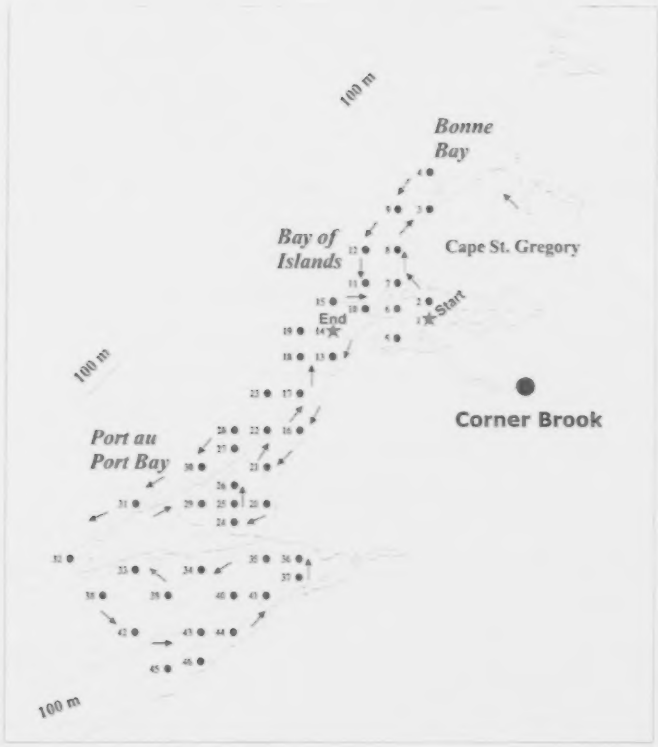
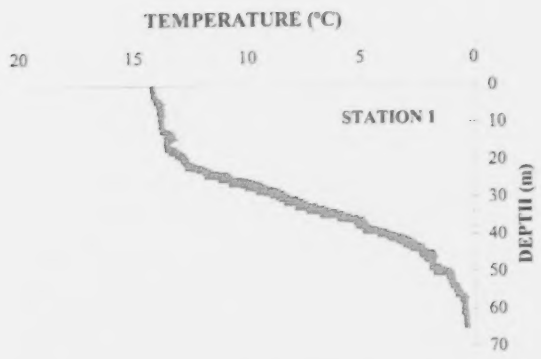


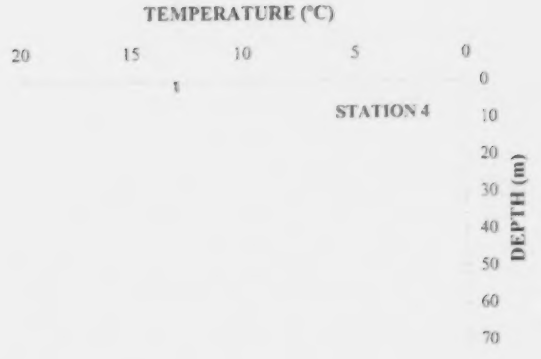
Figure 2. Map of the 39-station sampling grid of the capelin and Atlantic herring larval survey of July 2009.

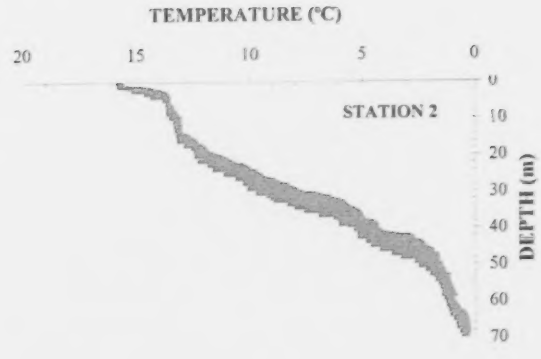
Figure 3. Mean water temperature (°C) by depth intervals of 2 m from 0 m to 20 m and intervals of 5 m between 20 m and 55 m.

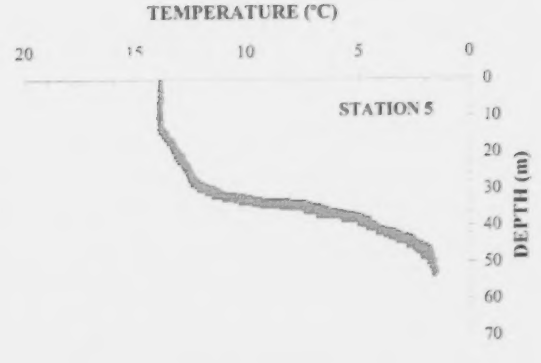
Figure 3. (Continued).

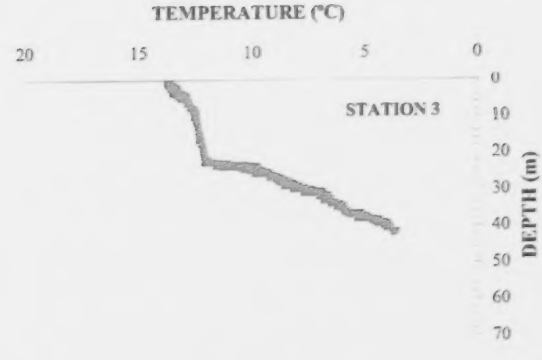
Appendix 1. Temperature profiles for stations sampled during the capelin and Atlantic herring larval survey of July 2009 on the west coast of Newfoundland.

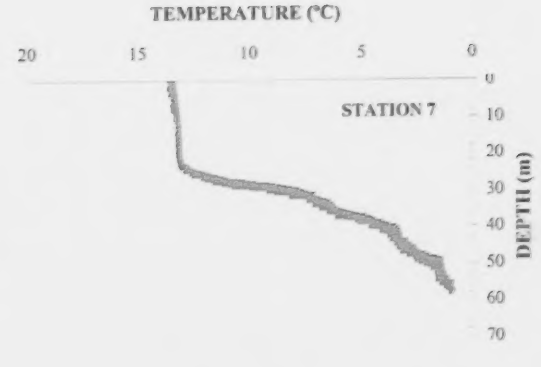

TEMPERATURE (°C)
20
15
10
5
0
STATION 1
DEPTH (m)
0
10
20
30
40
50
60
70

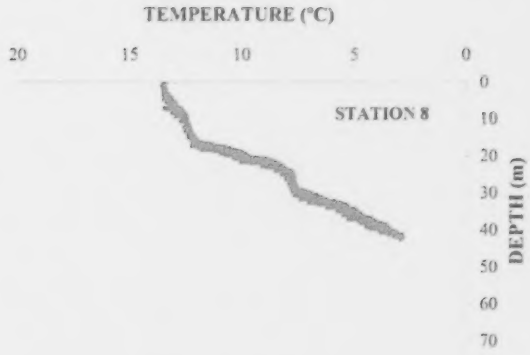

TEMPERATURE (°C)
20
15
10
5
0
STATION 4
DEPTH (m)
0
10
20
30
40
50
60
70

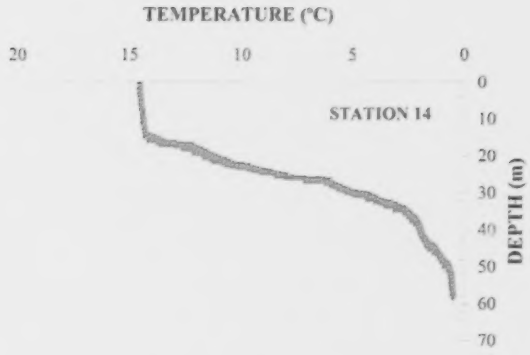

TEMPERATURE (°C)
20
15
10
5
0
STATION 2
DEPTH (m)
0
10
20
30
40
50
60
70

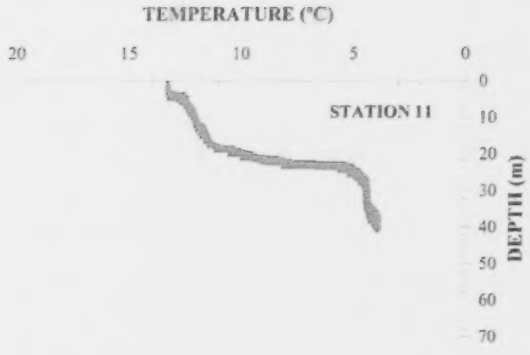

TEMPERATURE (°C)
20
15
10
5
0
STATION 5
DEPTH (m)
0
10
20
30
40
50
60
70

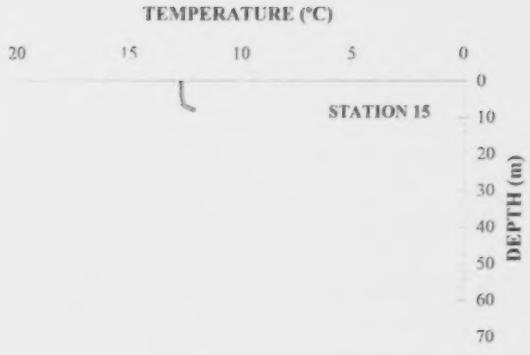

TEMPERATURE (°C)
20
15
10
5
0
STATION 3
DEPTH (m)
0
10
20
30
40
50
60
70

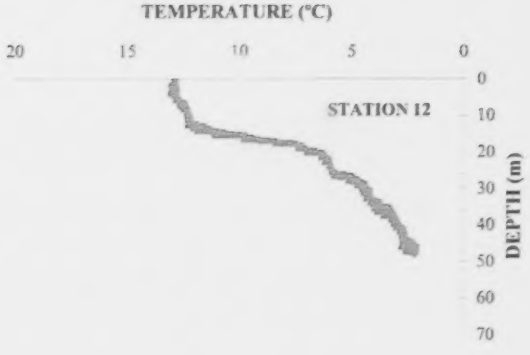

TEMPERATURE (°C)
20
15
10
5
0
STATION 7
DEPTH (m)
0
10
20
30
40
50
60
70

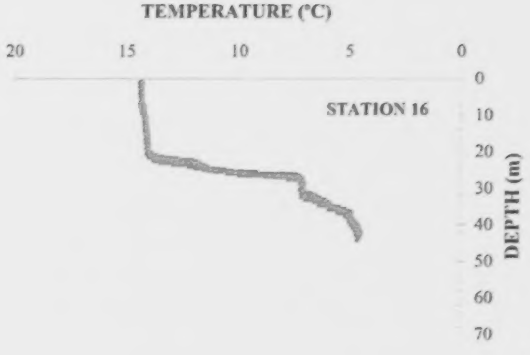

TEMPERATURE (°C)
20
15
10
5
0
STATION 8
0
10
20
30
40
50
60
70
DEPTH (m)

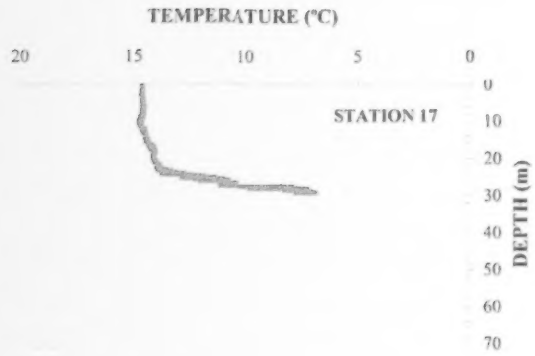

TEMPERATURE (°C)
20
15
10
5
0
STATION 14
0
10
20
30
40
50
60
70
DEPTH (m)

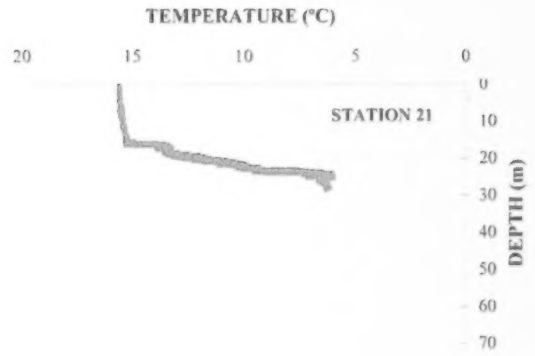

TEMPERATURE (°C)
20
15
10
5
0
STATION 11
0
10
20
30
40
50
60
70
DEPTH (m)

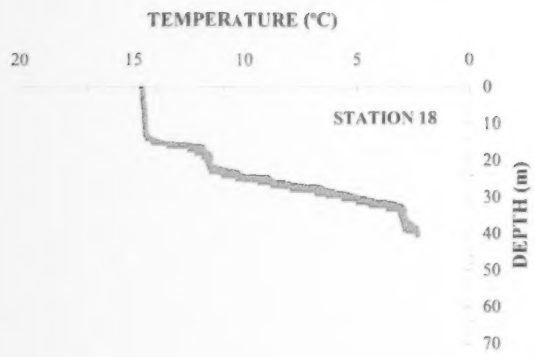

TEMPERATURE (°C)
20
15
10
5
0
STATION 15
0
10
20
30
40
50
60
70
DEPTH (m)

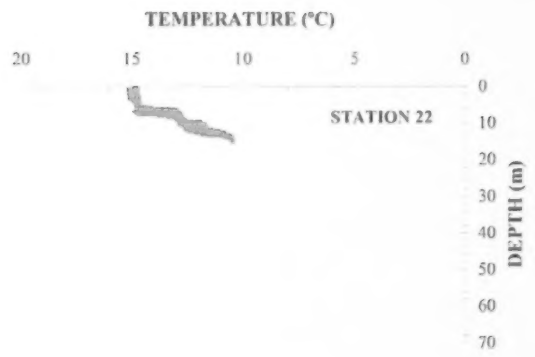

TEMPERATURE (°C)
20
15
10
5
0
STATION 12
0
10
20
30
40
50
60
70
DEPTH (m)

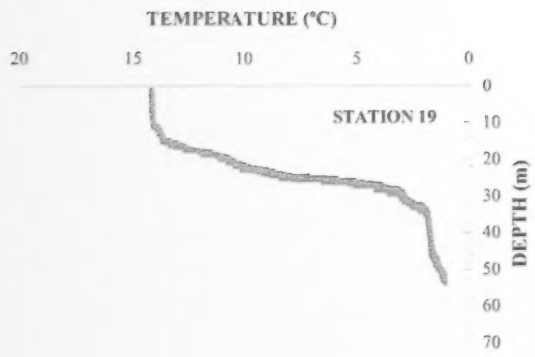

TEMPERATURE (°C)
20
15
10
5
0
STATION 16
0
10
20
30
40
50
60
70
DEPTH (m)

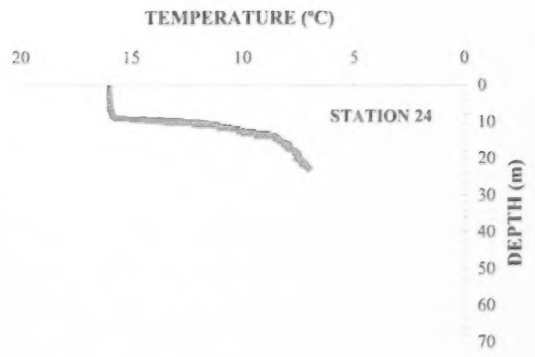

TEMPERATURE (°C)
20
15
10
5
0
STATION 17
DEPTH (m)
0
10
20
30
40
50
60
70

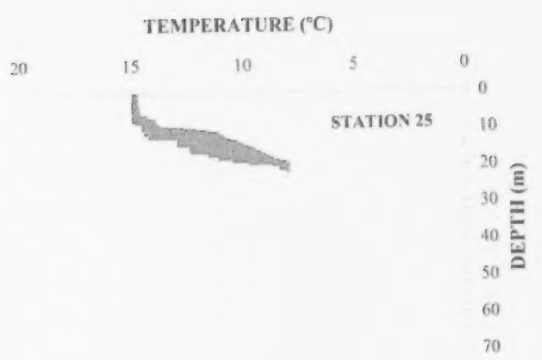

TEMPERATURE (°C)
20
15
10
5
0
STATION 21
DEPTH (m)
0
10
20
30
40
50
60
70


TEMPERATURE (°C)
20
15
10
5
0
STATION 18
DEPTH (m)
0
10
20
30
40
50
60
70


TEMPERATURE (°C)
20
15
10
5
0
STATION 22
DEPTH (m)
0
10
20
30
40
50
60
70


TEMPERATURE (°C)
20
15
10
5
0
STATION 19
DEPTH (m)
0
10
20
30
40
50
60
70


TEMPERATURE (°C)
20
15
10
5
0
STATION 24
DEPTH (m)
0
10
20
30
40
50
60
70


TEMPERATURE (°C)
20
15
10
5
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STATION 25
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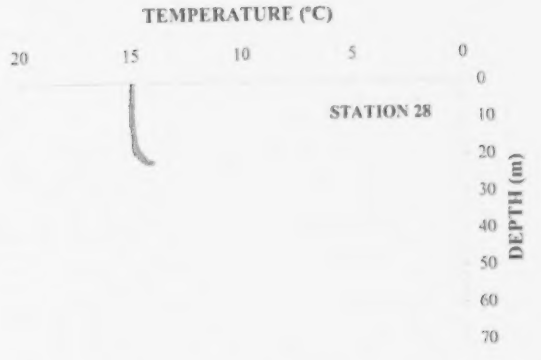
60
70
DEPTH (m)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STATION 28
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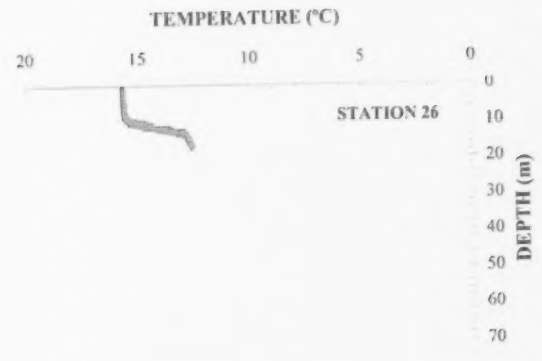
DEPTH (m)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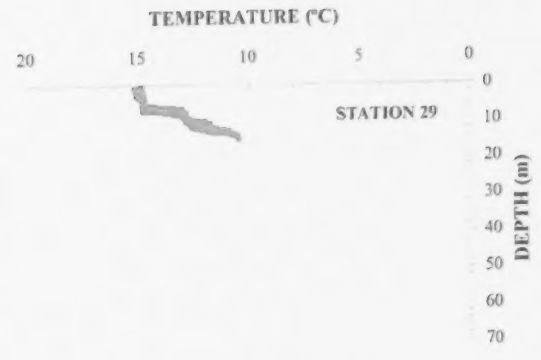
DEPTH (m)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STATION 29
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60
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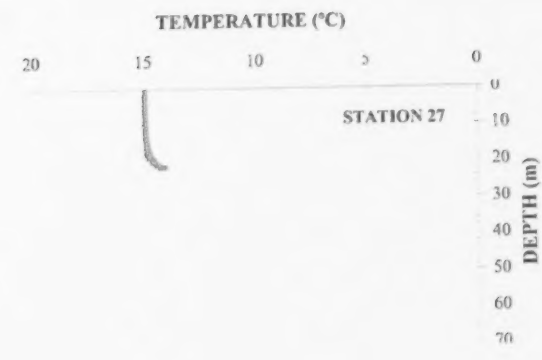
DEPTH (m)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0
STATION 27
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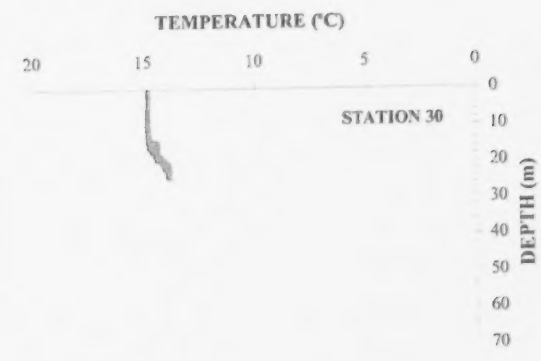
10
20
30
40
50
60
70
DEPTH (m)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STATION 30
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20
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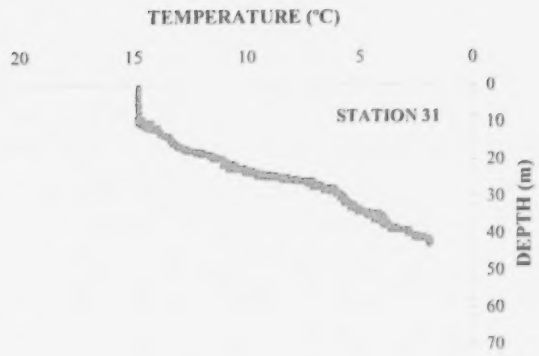
40
50
60
70
DEPTH (m)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STATION 31
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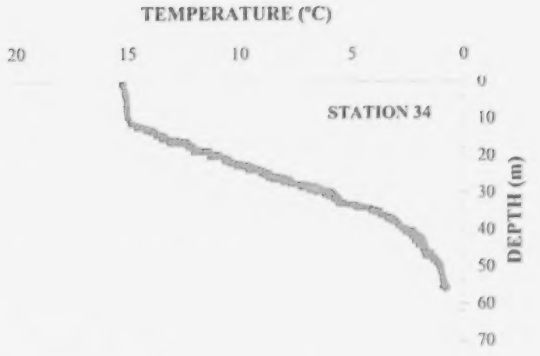
20
30
40
50
60
70
DEPTH (m)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STATION 34
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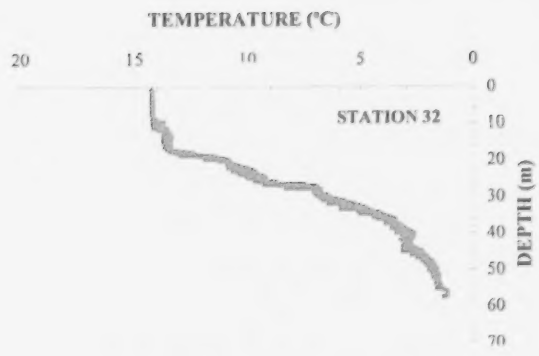
20
30
40
50
60
70
DEPTH (m)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STATION 32
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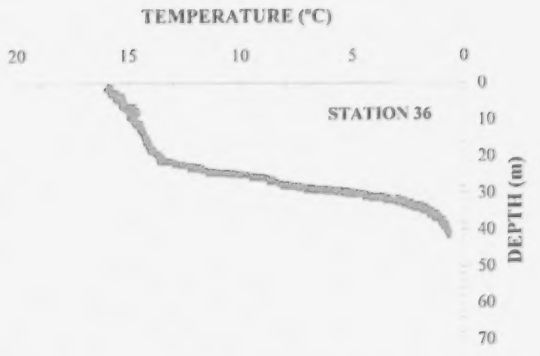
20
30
40
50
60
70
DEPTH (m)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STATION 36
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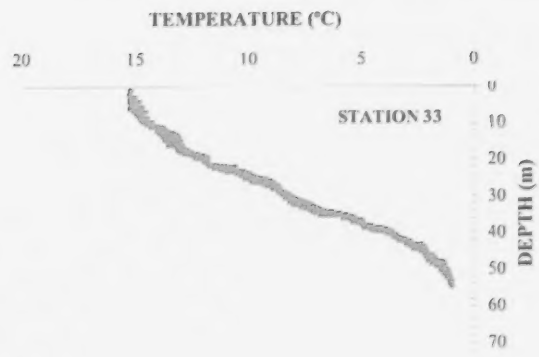
20
30
40
50
60
70
DEPTH (m)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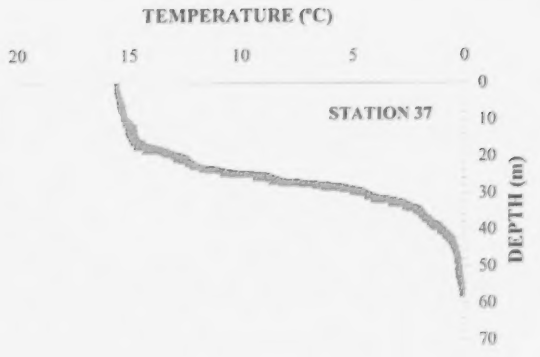
20
30
40
50
60
70
DEPTH (m)


TEMPERATURE (°C)
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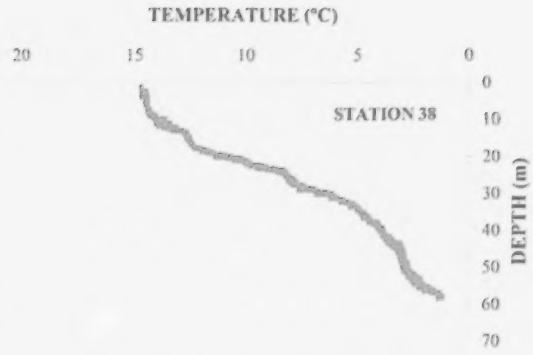
STATION 37
0
10
20
30
40
50
60
70
DEPTH (m)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5
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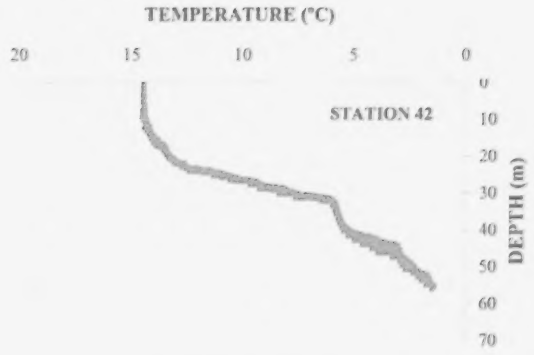
STATION 38
0
10
20
30
40
50
60
70
DEPTH (m)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STATION 42
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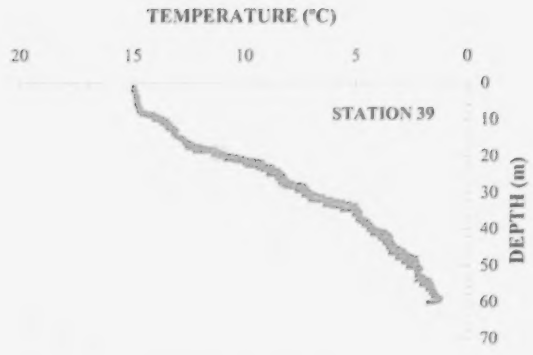
20
30
40
50
60
70
DEPTH (m)


TEMPERATURE (°C)
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5
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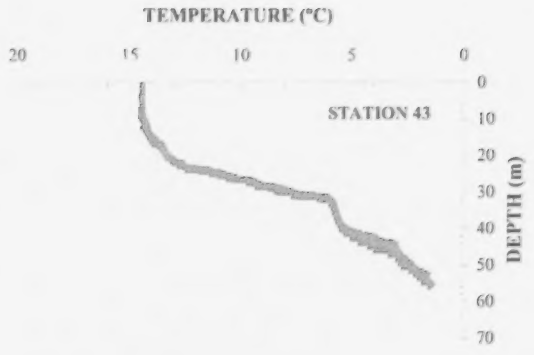
STATION 39
0
10
20
30
40
50
60
70
DEPTH (m)


TEMPERATURE (°C)
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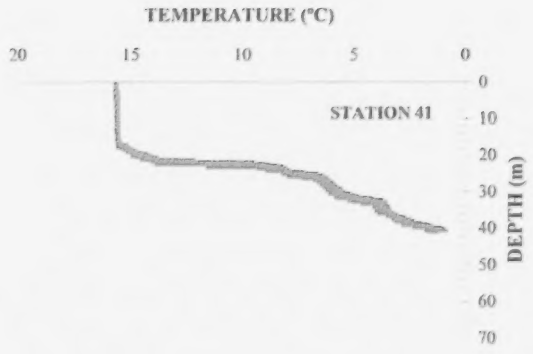
5
0
STATION 43
0
10
20
30
40
50
60
70
DEPTH (m)


TEMPERATURE (°C)
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15
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5
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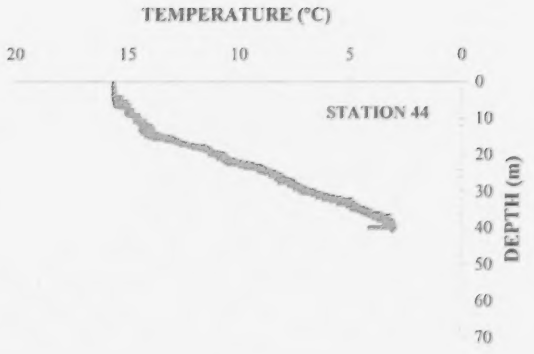
STATION 41
0
10
20
30
40
50
60
70
DEPTH (m)


TEMPERATURE (°C)
20
15
10
5
0
STATION 44
0
10
20
30
40
50
60
70
DEPTH (m)

Appendix 2. Volume of the plankton sample (mL) and number of eggs sorted and identified from samples collected during the capelin and Atlantic herring larval survey of July 2009 on the west coast of Newfoundland. Egg codes are as follows: H4B = hake (*Urophycis* spp.), fourbeard rockling (*Enchelyopus cimbrius*), and butterfish (*Peprilus triacanthus*); CHW = cod (*Gadus morhua*), haddock (*Melanogrammus aeglefinus)*, and witch flounder (*Glyptocephalus cynoglossus*); CYT = cunner (*Tautogolabrus adspersus*) and yellowtail flounder (*Limanda ferruginea*).

Descriptions and pictures of mackerel eggs are found in Girard (2000).

Station	Sample volume (mL)	Eggs (n)									
		Mackerel					H4B	CHW	CYT	American plaice *(Hippoglossoides platessoides)*	Windowpane flounder *(Scophthalmus aquosus)*
		Stage 1	Stage 2	Stage 3	Stage 4	Stage 5					
1	264	6	0	14	42	10	4	18	1 684	2	5
2*	19	4	0	10	6	1	0	19	470	0	1
3	254	43	9	13	12	8	3	100	99	0	1
4	286	11	4	5	0	2	1	44	11	1	0
5	291	44	21	30	12	4	0	11	1 552	4	4
6**	---	---	---	---	---	---	---	---	---	---	---
7	309	37	35	38	33	5	6	48	1 592	1	8
8	297	1	2	2	2	0	1	137	25	3	0
9***	305	1	3	2	4	0	2	47	10	0	0
10**	---	---	---	---	---	---	---	---	---	---	---
11	352	9	18	13	3	3	0	320	8	12	1
12	259	6	4	9	4	2	0	30	3	1	0
13***	350	31	19	4	2	3	3	176	240	0	0
14	266	3	4	1	0	0	2	136	3	1	0
15	183	3	1	2	0	2	0	25	1	0	0
16	281	156	28	10	31	7	17	125	4 800	0	31
17	319	162	20	5	0	16	1	76	512	0	1
18	266	8	3	1	0	0	3	28	16	0	0
19	230	2	0	0	1	0	2	256	0	0	0
20***	242	127	8	6	6	16	48	3	45	0	0
21	287	256	124	136	100	56	16	8	34 304	0	4
22	287	240	14	22	22	10	12	272	8 384	0	4
23**	---	---	---	---	---	---	---	---	---	---	---
24	234	130	92	96	16	40	456	2	208	0	0
25	219	93	11	31	16	4	288	0	504	0	24
26	238	17	3	4	3	1	224	3	1 032	0	360
27	306	102	7	7	10	4	59	128	3 200	0	9
28	284	40	0	1	2	8	4	192	26	2	3

Station	Sample volume (mL)	Eggs (n)									
		Mackerel					H4B	CHW	CYT	American plaice *(Hippoglossoides platessoides)*	Windowpane flounder *(Scophthalmus aquosus)*
		Stage 1	Stage 2	Stage 3	Stage 4	Stage 5					
29	255	5	0	0	0	0	160	0	0	0	160
30	275	42	3	1	4	1	0	232	160	0	0
31	313	149	15	3	4	6	3	168	1472	0	2
32	127	0	0	0	0	1	0	112	9	0	0
33	288	3	1	4	2	1	0	232	80	0	0
34	257	3	8	21	11	1	1	184	160	3	0
35**	---	---	---	---	---	---	---	---	---	---	---
36	316	44	200	104	48	48	8	16	2188	0	24
37	257	56	32	23	26	14	1	17	1088	0	13
38	295	14	3	1	0	1	1	224	128	0	0
39	182	4	6	7	2	1	0	224	144	0	1
40**	---	---	---	---	---	---	---	---	---	---	---
41	384	24	27	12	8	6	4	208	3392	3	0
42	248	2	7	9	7	1	1	56	328	2	0
43	236	1	1	3	8	0	2	80	88	0	0
44	224	10	2	5	2	0	1	176	31	1	0
45**	---	---	---	---	---	---	---	---	---	---	---
46**	---	---	---	---	---	---	---	---	---	---	---

* Nets damaged

** Not sampled (bad weather)

*** Malfunction of the CTD probe

Appendix 3. Number of larvae sorted and identified from samples collected during the capelin and Atlantic herring larval survey of July 2009 on the west coast of Newfoundland. Scientific names are as follows: mackerel (*Scomber scombrus*), sandlance (*Ammodytes* spp.), herring (*Clupea harengus harengus*), cod (*Gadus morhua*), American plaice (*Hippoglossoides platessoides*), snailfish (*Liparis* spp.), capelin (*Mallotus villosus*), redfish (*Sebastes* spp.), arctic shanny (*Stichaeus punctatus*), radiated shanny (*Ulvaria subbifurcata*), fourbeard rockling (*Enchelyopus cimbrius*), witch flounder (*Glyptocephalus cynoglossus*), yellowtail flounder (*Limanda ferruginea*), winter flounder (*Pseudopleuronectes americanus*), righteye flounder (Pleuronectidae), cunner (*Tautogolabrus adspersus*), and windowpane flounder (*Scophthalmus aquosus*). Also included are counts of broken and other unidentified larvae.

Station	Mackerel	Sandlance	Herring	Cod	American plaice	Snailfish	Capelin	Redfish	Arctic shanny	Radiated shanny	Fourbeard rockling	Witch flounder	Yellowtail flounder	Winter flounder	Righteye flounder	Cunner	Windowpane flounder	Broken larvae	Other larvae not identified
1	4	0	10	0	2	0	13	0	2	0	0	0	1	1	2	19	0	1	0
2*	0	0	1	0	0	0	37	0	2	0	0	0	4	0	0	8	1	1	0
3	4	0	5	2	2	4	231	0	0	11	3	15	17	2	0	56	0	2	0
4	0	0	8	0	1	3	4	0	0	1	0	2	6	0	0	4	0	0	0
5	0	0	15	0	0	3	13	0	1	0	0	0	2	0	0	30	1	0	0
6**	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
7	5	0	2	1	4	2	19	0	0	7	1	1	5	1	0	26	0	1	0
8	2	3	3	0	0	6	27	0	0	5	0	16	25	0	0	22	0	2	1
9***	0	0	14	2	0	1	2	1	0	3	0	13	39	0	0	10	0	3	0
10**	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
11	1	0	2	5	0	4	0	1	0	0	0	2	10	0	0	1	0	0	0
12	1	0	5	0	0	4	3	1	0	1	0	11	28	0	0	9	0	2	0
13***	1	0	0	2	0	4	96	1	0	3	4	14	9	0	0	68	0	0	0
14	1	0	7	3	0	2	1	3	0	0	0	5	8	0	0	6	0	1	1
15	0	0	15	2	1	4	0	2	0	1	0	0	0	0	0	0	0	0	0
16	4	0	2	0	0	3	6	1	1	1	0	16	15	0	0	85	0	0	0
17	7	0	0	0	0	0	14	0	0	13	1	24	24	0	0	108	0	0	0
18	0	0	7	5	0	2	0	1	0	1	0	26	7	0	0	34	0	1	3
19	1	0	17	1	0	2	1	3	0	0	0	2	10	0	0	3	0	1	1
20***	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	7	0	0	0
21	4	0	0	0	0	0	60	0	0	0	4	0	4	0	0	172	0	0	0
22	20	0	0	0	4	0	6	0	0	16	4	2	22	2	0	1 056	4	2	2
23**	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
24	0	0	0	0	0	0	2	0	0	2	4	4	0	0	0	34	0	0	0
25	4	0	0	0	0	0	23	0	0	0	13	0	0	0	0	296	0	0	0
26	0	0	0	0	0	0	0	0	0	0	2	6	1	0	0	12	0	0	0
27	4	0	1	5	0	0	1	0	0	6	0	3	9	3	0	896	0	0	0
28	2	0	3	12	0	1	0	1	0	0	1	16	20	0	0	6	0	0	1

Station	Mackerel	Sandlance	Herring	Cod	American plaice	Snailfish	Capelin	Redfish	Arctic shanny	Radiated shanny	Fourbeard rockling	Witch flounder	Yellowtail flounder	Winter flounder	Righteye flounder	Cunner	Windowpane flounder	Broken larvae	Other larvae not identified
29	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	2	0	1	0
30	5	0	1	4	0	0	0	0	0	7	2	24	13	0	0	168	0	0	0
31	14	0	5	14	0	17	0	0	0	2	2	22	24	1	0	56	0	0	1
32	0	0	1	1	0	3	0	11	0	0	1	0	0	0	0	1	0	0	0
33	8	0	3	10	1	1	5	4	0	0	2	112	68	2	0	34	0	3	6
34	16	0	19	1	0	1	0	0	0	0	1	6	15	1	0	32	4	0	0
35**	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
36	80	0	4	0	0	0	172	0	0	0	0	48	92	0	0	60	8	4	0
37	46	0	13	1	0	0	30	0	0	1	1	0	12	0	0	96	1	1	0
38	3	0	5	6	0	2	1	1	0	1	1	32	27	0	0	5	0	0	0
39	7	1	8	1	0	2	9	0	0	0	0	5	2	0	0	5	0	2	1
40**	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
41	15	0	0	0	0	0	0	1	0	1	1	0	5	6	0	264	3	0	0
42	4	0	2	4	0	1	4	0	0	1	0	6	8	1	0	21	0	0	1
43	17	0	2	6	0	1	2	0	0	1	1	16	19	0	0	20	1	0	1
44	54	0	7	9	0	2	5	1	0	0	1	10	10	1	0	320	4	4	3
45**	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
46**	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

* Nets damaged

** Not sampled (bad weather)

*** Malfunction of the CTD probe